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STEEL-MELTING FOR SHAPE-CASTING

A session of the All-Union Scientific and Technical Foundrymens' Society was recently held in Moscow to exchange production experience and the latest achievements of advanced science in the field of steel production for shapecasting.

There were 212 participants in the session: 145 representatives of various plants, 15 from ministries, and 52 from scientific research institutes. Altogether, 26 technical papers were presented and discussed.

N. N. Dobrokhotov, Active Member, Academy of Sciences Ukrainian SSR, in his report "Fundamentals of the Technology of Melting and Pouring Steel for Shape-Casting," summarized results of the joint activity of Soviet scientists and production engineers, and outlined radical changes in certain generally recognized concepts of steel-melting technology. For example, the usual concentration of manganese in metal during the boiling period is not obligatory at all. He disputes a widely accepted assumption that pouring of extremely overheated metal causes high rejection of castings due to hot cracks, porosity, and improper structure, and advances a new principle: the higher the pouring temperature of steel, the better the quality of castings and the lower the percentage of rejection; the harmful effect of low pouring temperatures cannot be offset by any change in the pouring rate. Rates of steel-pouring accepted by norms thus may be considerably increased with appropriate improvement in the quality of castings.

The report aroused great interest, and by special request of the participants Dobrokhotov delivered a lecture on the contemporary theory of metallurgical processes in steel-melting.

Professor L. M. Mariyenbakh delivered a report, "The Kinetics of Chemical Reactions in Metallurgical Processes," in which he presented a new theory of the velocities of reversible processes taking place in a liquid phase. He demonstrated that, with temperature rise, in the beginning an exothermic reaction takes place in the system; the velocity of this reaction grows with the temperature rise, attains its maximum, and then drops to zero. Further rise of temperature causes a reversible endothermic reaction, the velocity of which also increases with further temperature rise; the temperature at which the reaction changes its trend is specific

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for each element. The theory explains all peculiarities and the sequence of the burning out of various elements in the melting of cast iron and steel and the process of steel deoxidation.

Engineer S. N. Mylko, in his paper "The Contemporary Technology of Steel Production for Shape-Casting," presented information on peculiarities of the technology of steel-melting in open-hearth furnaces at the Voroshilovgrad Locomotive Plant, and on those scientific research works which served as a basis for the development of this technology. Its application has made possible conducting of rapid melts, elimination of rejection due to porosity, decrease in consumption of pig iron and ferromanganese, and improvement in the mechanical properties of steel and particularly in its plastic properties.

Engineer V. P. Tunkov, Stalin Prize Laureate, Engineer Ya. L. Rozenblot, and S. L. Freydlin, Candidate of Technical Sciences, established in their reports that the maximum deoxidation of metal and slag and the minimum content of phosphorus in metal must be achieved in melting high-manganese steel by the basic open-hearth process. It should be taken into consideration that a large amount of phosphorus is introduced with addition of ferromanganese, and therefore partial replacement of the latter with silicomanganese gives good results.

Manufacture of high-manganese steel by the acid electric-arc process, based on the mixing in the ladle of carbon steel with ferromanganese, melted in a cupola or an oil furnace, or with preheated solid ferromanganese, gives high-quality steel homogeneous in chemical composition.

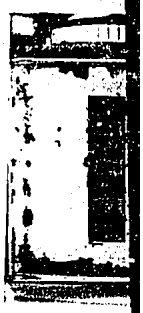
To obtain high wear-resistance of castings, heat treatment is required for securing uniform austenitic structure without carbides.

Engineer K. Kh. Khayrov submitted a report entitled "Method for Dephosphorization of Steel in the Acid Electric Furnace." He discussed experimental melts of steel containing ordinary charge with the phosphorus content brought to 0.04% by making basic oxidizing slag immediately after melting the metal, when the furnace lining is not yet very hot. Subsequently, the phosphorus slag is removed and the new slag is formed.

V. A. Grigor'yan, Candidate of Technical Sciences, in his report "Influence of Deoxidizers on Decreasing the Harmful Effect of Sulfur in the Acid Electric Furnace," presented the results of an investigation into the effect of various deoxidizers on the mechanical properties of medium-carbon steel. It has been established that the most expedient method for deoxidizing steel, melted in an electric furnace with acid lining, is the application of a silicon-manganese-calcium alloy (KMK), which provides for better fluidity and higher plasticity than when the steel is deoxidized with aluminum.

M. A. Perov, Candidate of Technical Sciences, in his paper "Application of Acid Electric Steel for Large Castings of Complex Shape," reported, on the basis of production experience, that steel melted in the acid electric furnace has mechanical properties almost equal to those of steel made in the basic furnace, under condition of removal of oxidized slag at the beginning of the melt, slag deoxidation with ground coke at the end of the melt, and final deoxidation with silico-calcium and magnesium.

Engineer M. V. Lipov, in his report "Technology of Steel Production for Shape-Casting in Electric-Arc Furnaces at the NKMZ Plant imeni Stalin," stated that the Novo-Kramatorsk Machine-Building Plant, which produces various and often unique castings, secures required qualities of steel in castings by the use of basic electric furnaces, careful selection of materials for furnace lining, charge, and fluxes, and also by strict observation of technology, controlling the entire course of the melt with proximate analysis for determination of all elements during the melting process and with temperature measuring.



Engineer Z. N. Khavin, in his report "New Method for Melting Acid-Resistant Steel in the Electric Furnace," described a new method developed at the Plant imeni Lepse for making chrome-nickel steel out of a charge made entirely of scrap.

S. Ya. Karmazin, Doctor of Technical Sciences, presented his paper "Combined Processes of Steel Melting for Shape Casting," in which he suggested a new process for melting steel successively in a cupola with basic lining and oxygen blast, in a side-blown converter, and in a steel-melting unit made up of an electric-arc furnace and an electric mixer fed with current from a single three-phase transformer.

Engineer M. Yu. Baycher, in his report "New Mechanized Furnaces of Domestic Make," outlined and analyzed the parameters of all electric melting furnaces designed by the "Elektrostal" Trust, technical and economical considerations for selection of furnace power, and operation indexes of modern electric furnaces.

B. N. Ladyzhenskiy, Candidate of Technical Sciences, in his report "Development of Steel Production for Shape Casting in Side-Blown Converters," discussed the quality indexes for various grades of carbon and alloy steels made in side-blown converters. He showed possibilities for further improvement in quality and for increases in the production of converter steel, using the cupola with basic lining for removal of sulfur from pig iron without temperature drop and interrupting the blowing process at required carbon concentration, incorporating instruments for rapid determination of carbon in the steel.

Engineer V. M. Pishchev, in his report "Production of High-Carbon Steel out of the Side-Blown Converter," commented on the experiment of producing steel with up to 1.2% C by the method of mixing in the ladle steel, blown and deoxidized with ferromanganese in the converter, with pig iron.

S. O. Byalinitskiy-Birulya, Candidate of Technical Sciences, in his report "Shape-Casting out of Thermit Steel" suggested fabrication of castings out of steel, obtained by the thermit method, in the case of urgency in obtaining the castings or when the pouring operation has to be performed right next to the source of molten metal.

N. S. Kreshchanovskiy, Candidate of Technical Sciences, in his paper "Modification of Steel As a Method for Improving Its Mechanical and Technological Properties," reported, on the basis of research works and industrial tests, that in-the-ladle additions of a number of elements change not only crystallization processes and mechanical properties of steel, but also its technological characteristic. Modification of steel may decrease, to a great extent, the concentration of gases, sulfur, and nonmetallic inclusions and increase the density of metal improving its mechanical properties. Selection of a modifier must take into consideration the grade of steel, since the same modifier may have different effects.

V. G. Gruzin, Candidate of Technical Sciences, in his report "Methods for Measuring the Temperature of Liquid Steel in Melting Furnaces," described a pyrometer designed at TsNIITMASh for measuring the temperature of liquid steel by submersion, with maximum measuring error from + 0.8 to - 1.5%.

Engineer T. B. Tatarskaya, in her report "Basic Crucibles for High-Frequency Furnaces," suggested heat-resistant chromomagnesite as lining material for large and small crucibles.

Professor Yu. A. Nekhendzi, Doctor of Technical Sciences, in his paper "The Fluidity of Steel as a Technological Index of Its Quality in the Melting Process," on the basis of numerous investigations conducted jointly with A. M. Samarin, Corresponding Member, Academy of Sciences USSR, established direct relationship among the fluidity indexes of steel, the quantity and shape of nonmetallic inclusions in steel, and certain properties of steel in castings. The better the fluidity of steel, the higher are the indexes of its plasticity and impact strength.

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Engineer S. I. Sapiro in his report "Hydromechanical Processes of Melting and Crystallization of Steel," and S. M. Baranov, Candidate of Technical Sciences, in his report "On Interrelation of Certain Properties of Liquid and Solid Steel," showed that study of surface phenomena in connection with capillary-hydromechanical processes may give scientific substantiation and satisfactory solution of complex problems in the field of steelmaking.

O. S. Raynus, Candidate of Technical Sciences, in his paper "Modification of the Macro- and Microstructure of Steel in Samples Taken in the Course of Heat," reported the results of investigation into the structure of steel in respect to changes in its chemical composition. It was established that the Widmanstatten structure appears only at a definite content of carbon and manganese.

The resolution adopted at the close of the session suggested the elimination of certain unsubstantiated operations from steelmaking practice and the introduction of new materials and progressive methods.

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